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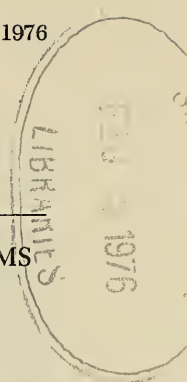
TWO NEW GENERA OF EUDRILID EARTHWORMS
FROM NIGERIA

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Few earthworms have previously been described from Nigeria and as such undescribed species are sometimes found when new collections are made. Among the eudrilid earthworms, Beddard (1891a & 1891b) described four genera and species—*Hyperiodrilus africanus*, *Heliiodrilus lagosensis*, *Libyodrilus violaceus* and *Iridodrilus roseus*—from collections made in Lagos. Michaelsen (1913) recorded *Eudrilus eugeniae* from Old Calabar, Southern Nigeria and in 1915, he described *Beddardiella dalzieli* and *Eutoreutus abinsianus* from Northern Nigeria. Taylor (1949) described a new species, *Hippopera nigeriae* from Lagos and Ibadan. Clausen (1963) described two new species belonging to a new genus, *Keffia variabilis* and *K. nigeriensis* from Keffi, Jos and Kano, Northern Nigeria and *Libyodrilus mekoensis* from Meko on the Nigeria—Dahomey boundary in 1965. In a collection from Ibadan, Sims (1971) described a new genus and species, *Ephyriodrilus afroccidentalis* and recorded occurrence of *Eminoscolex steindachneri*. Segun described two new species of *Hyperiodrilus* from western and mid-western states of Nigeria (in press).

The present paper deals with the description of two new genera and species of earthworms collected from the garden soil of catering Rest houses in Vom and Jos, Benue-Plateau State, and from a farm land of the University of Nigeria, Nsukka, East Central State. Other eudrilid earthworms identified during these collections were species of *Eudrilus*, *Hyperiodrilus*, *Iridodrilus* and *Keffia*.



COLLECTING TECHNIQUES

Earthworms are collected in terrestrial habitats by digging or by direct application of dilute solution of formalin (18 ml. of 40% formaldehyde in 4.5 liters of water) or about 25 ml. of concentrated formaldehyde to an area of 1.5 square meters. A dilute solution of potassium permanganate can also be used. The worms obtained when using these solutions are washed in water for a few minutes as soon as they appear on the surface.

Vomia, new genus

Description: Eudrilinae with ab setae fairly widely, cd setae more closely paired. Male pores closely applied midventrally on segment XVII; female pores paired laterally on segment XIV; spermathecal pores paired midventrally in XIII, anterior to female pores. Oesophageal gizzard present in segment VI, intestinal gizzards and suprainestinal glands absent. Unpaired ventral oesophageal sacs present in segments X and XI, paired dorsolateral oesophageal glands in segment XII. Holandric, 2 pairs of testes enclosed in testis sacs forming sperm reservoirs in X and XI. Paired ovo-spermathecal apparatus completely separate but connected by a short duct. Ovaries paired and enclosed in ovarian sacs in segment XIII, each ovary leading by a narrow tube into an ovisac which communicates with a fertilisation chamber at the inner (ental) end of the oviduct. Each oviduct opens out ventrolaterally in segment XIV near 13/14 furrow. Spermathecal receptacula seminis paired, left and right parts completely separate in their whole length. Small, paired, muscular spermathecal ampullae present. Paired penial setae present in segment XVII.

Distribution: Benue-Plateau State, Northern Nigeria.

Type-species: *Vomia prima* new species.

Remarks: The genus belongs to the *Eudrilus-Metascolex-Parascolex-Hippopera* group of West African Eudrilidae by possessing paired oesophageal glands in segment XII and ventral, unpaired, oesophageal sacs in X and XI. It resembles *Parascolex*, *Hippopera* and *Metascolex* in having separate openings for spermatheca and oviduct, but differs from *Metascolex* which possesses only one pair of testes and vesiculae seminales, and also from *Parascolex* by the single nature and the positions of the male and spermathecal pores. The spermatheca is also single in *Parascolex* for the greater part of its length. *Vomia* resembles *Eudrilus* and *Hippopera* in possessing paired male and spermathecal pores, but differs chiefly from *Eudrilus* by having separate openings for the oviducts and the spermathecae. Penial setae present in *Vomia* are completely absent in *Eudrilus*. *Hippopera* differs from *Vomia* in possessing a pair of prostatic pores (anterior male pores, Taylor, 1949) on segment XIV and clitellar pouch which covers most of the floor of the clitellum.

Vomia prima, new species

Figures 1-2, 4

26 clitellate specimens collected from the type-locality are now kept in the Natural History Museum, University of Ife, Ile-Ife, Nigeria. Reg. No. 1973.1.1-26.

3 clitellate specimens. British Museum (Natural History) Reg. No. 1973.27.4-6.

External characters: The lengths of the earthworms vary from 120 mm and the diameters in the clitellar region from 6 to 9 mm. The number of segments varies from 130 to 190. The dorsal side of the body is grey with bluish tinge, whilst the ventral side is light grey; the clitellum is light orange. The prostomium is epilobous. The clitellum is annular, occupying segments XIII to XVII. Dorsal pores are absent.

The setae have an eudriline arrangement with $ab > cd$; the setal formula ($aa:ab:bc:cd$) at segment X is 6:1-2:4:1, at segment XX = 16:2:6:1 and at segment XXX = 15:2:4:1. $dd = \frac{1}{2}$ circumference.

The male pores are paired between aa on segment XVII, very near 17/18 intersegmental furrow where they are situated on the apices of two small protuberances. These, in turn, are found in a shallow, oval depression occupying segments XVII and XVIII (Fig. 1). Penial setae are often visible inside the pores.

The female pores are paired on small rounded papillae on XIV outside setal line d , within dd .

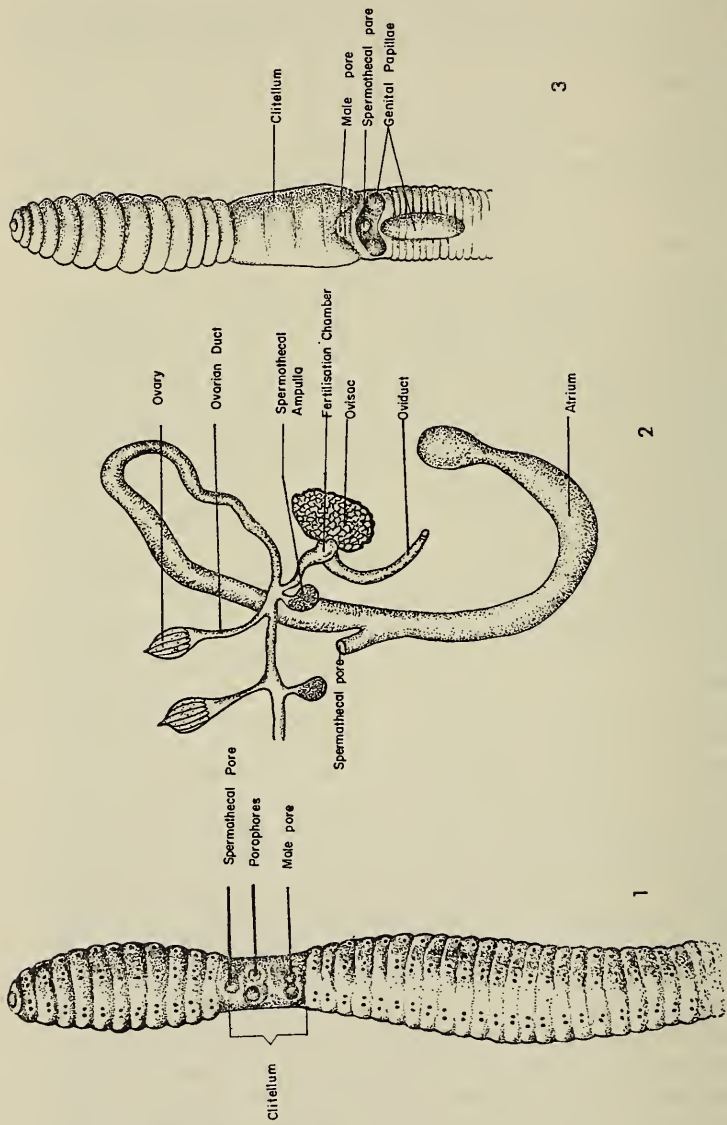
Spermathecal pores are closely paired and situated in two small depressions within setal lines aa on furrow 13/14 (Fig. 1).

A pair of porophores occupying the positions of ab on both sides are found on segment XV. No other genital papillae and markings are present.

The nephridiopores are paired in the posterior wall of each furrow within setal line cd , near c .

Internal characters: The first septum is 4/5. Septum 5/6 is thin; septa 6/7 to 9/10 are conical being distended by the muscular pharynx; 10/11 and 11/12 are muscular and 12/13 is less muscular.

The pharynx extends to segment IV where it leads into the oesophagus. In segment VI, the oesophagus dilates to form a large, very muscular gizzard which extends backwards to the level of segment IX. From segment VII to XV, the oesophagus is undifferentiated apart from the unpaired, midventral, pear-shaped sacs in segments X and XI, and the paired, dorsolateral glands in segment XII. These stalked oesophageal glands are closely applied to septum 12/13 and lie directly beneath the large, posterior vesiculae seminales. Each of these glands opens by a short duct into the oesophagus. The gut dilates to form the intestine in segment XV and this continues to the posterior end of the worm and terminates in an anus. The intestine is uniform throughout, intestinal gizzards, supra-intestinal glands and typhlosole being absent.



FIGS. 1-2. *Vomia prima*, n. sp.: 1, External features, ventral view; 2, Ovo-spermathecal system. FIG. 3, *Agrotoreutus nyongii*, n. sp., external features, ventral view.

The dorsal blood vessel passes anteriorly along the upper surface of the gut to segment VII where it breaks up into numerous tiny vessels to serve the gizzard. In segments X and XI, the dorsal vessel gives off branches to serve the oesophageal sacs. In the anterior region of segment XII, it gives off a pair of blood vessels, the left branch serving the oesophageal glands and the right dipping to join the subneural blood vessel. A pair of vessels are also given off in segment XIII and these run forwards to serve the same oesophageal glands. In the intestinal region, the dorsal vessel also gives off two pairs of parietal vessels in each segment. A subneural vessel runs on the left side of the ventral nerve cord from segment IX, then crosses to the right until it is joined in segment XII by the large right vessel emanating from the dorsal vessel. This subneural vessel then runs backwards directly underneath the ventral nerve cord. Branches of subneural vessel serve the female reproductive organs in segments XIII to XVI. The ventral blood vessel passes anteriorly below the gut to the pharyngeal region. It also gives off branches to serve the oesophageal gizzard. Commissural blood vessels connecting the dorsal with the supra-oesophageal blood vessel before passing down to the ventral vessel, are present anteriorly with one pair in each of segments VIII to XI.

The testes condition is holandric. Both anterior and posterior pairs are enclosed in pear-shaped sacs which lie closely against septa 10/11 and 11/12 respectively. Each of the sacs meets dorsally the opening of the corresponding vesicula seminalis with which it fuses. Ventrally, it leads into the vas deferens which pierces the septum immediately behind into the following segment. The vasa deferentia merge in segment XII and continue posteriorly to segment XVII where both of them enter into the anterior (ental) region of the euprostatic gland of its side. Vesiculae seminales are paired in segment XI and XII, the posterior pair being much larger than the anterior pair. Each of the two euprostatic glands is in the form of an elongate fingerlike process which possesses a swollen 'head' followed by a 'neck' (Fig. 4). These glands bend laterally outwards, and their ectal end is more muscular than the ental part. The sacs with the penial setae join the euprostates at the 'neck' region just behind the swollen, anterior ends. The sacs are attached to the body wall in segment XVII. The penial setae are dagger-shaped and each is divided into two mirror halves by a median line (Fig. 4).

The female generative organs are paired. Each ovary is enclosed within an ovarian capsule in XII where it lies by septum 12/13 on either side of the ventral nerve cord. An ovarian duct leads posteriorly from each capsule to an ovisac joined to the receptaculum ovorum (fertilisation chamber) (Figs. 2 & 4). The oviduct leads posterolaterally from the ectal end of each fertilisation chamber to the parietal wall in segment XIV traversing the 13/14 septum (Fig. 4).

The spermathecal system is paired. Each spermathecal pore leads to a very muscular, tubular receptaculum seminis which lies alongside

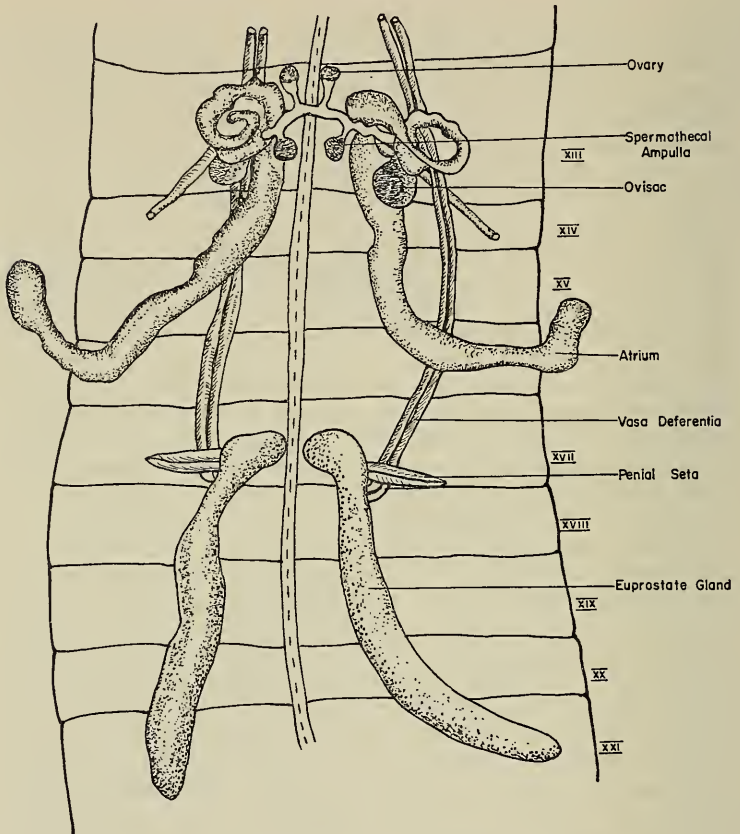


FIG. 4. *Vomio prima*, n. sp., reproductive system.

the ventral nerve cord. Sometimes, the posterior tips of the receptacula are tucked underneath the euprostate glands. Posteriorly, the receptaculum continues into segment XIV where it curves laterally and anteriorly, it narrows and curls up before joining the ovarian duct. A spermathecal ampulla is present as a small ovoid, muscular body on each side. A communication exists between the two ovo-spermathecal systems of both sides. This is in the form of a short, narrow duct connecting the two ovarian ducts (Fig. 2).

The excretory system is meganephridial with the nephridia in the clitellar regions being larger than the others. The reservoir (vesicle) of each nephridium is thick-walled and the middle portion of the nephridial duct is convoluted.

Agrotoreutus, new genus

Description: Eudrilinae with ab fairly widely, and cd more closely paired. Male pore is single on raised papilla on 17/18 furrow; female pores paired laterally on 13/14 furrow; spermathecal pore single, mid-ventrally on papilla on 20/21 furrow, close to segment XXI, and posterior to male pore. Paired rounded genital papillae on segments XX to XXII and an almond-shaped papilla on XXIII–XXXI. Oesophageal gizzard present in segment V, intestinal gizzards absent. Paired ventral oesophageal sacs present in segments IX, X and XI, paired kidney-shaped dorsolateral oesophageal glands in segment XIII. Typhlosole present. Holandric, two pairs of testes enclosed in testis sacs forming sperm reservoirs in segments X and XI. Euprostates usually long and tubular. Ovaries paired, enclosed in ovarian sacs in segment XIII. Each ovary, found usually attached to 12/13 septum near oesophageal glands, leads by a narrow short tube into an ovisac which communicates with a fertilisation chamber at the inner (ental) end of the oviduct. Each oviduct opens to the exterior ventro-laterally in 13/14 furrow near setal line d. Spermathecal atrium single, midventral dividing ectally into two diverticula (receptacula seminis). Two pairs of penial setae present in the form of rolled tubular setae in segment XVII.

Distribution: East Central State, Eastern Nigeria.

Type-species: *Agrotoreutus nyongii*, new species.

Remarks: The genus belongs to the *Polytoreutus-Eupolytoreutus-Eutoreutus* group. It resembles *Polytoreutus* Michaelsen and *Eupolytoreutus* Michaelsen in having an oesophageal gizzard in segment V, one pair of oesophageal glands in segment XIII, the male pore single on 17/18 furrow and the spermathecal pore single, midventral, lying behind the male pore. But, it differs from *Polytoreutus* which possesses one pair of testes, enclosed in sacs in segment XI. Paired penial setae which are present in the newly described genus are completely absent in *Eupolytoreutus* and *Polytoreutus*.

It also resembles *Keffia* Clausen and *Eutoreutus* Michaelsen in the positioning of oesophageal gizzard in segment V and oesophageal glands in XIII, and also in the spermathecal pore being situated behind the male pore. But, the male and the spermathecal pores are paired in *Keffia* as opposed to their being single in this genus and *Eutoreutus*. The ovo-spermathecal system of the genus being described seems to be similar to the structures described for the genus *Eutoreutus*, but in the former genus, there is no "muscular copulatory pouch either situated behind and separate from the spermatheca, or opening in common with its ectal extremity" (Stephenson (1930) p. 879). Furthermore, the ventral oesophageal sacs in segments VIII to XI or segment IX to XI are unpaired in *Eutoreutus* whereas those found in the presently described genus are paired in segments IX, X and XI. This earthworm is named after Mr. E. T. Nyong, formerly of University of Nigeria, Nsukka, who first sent me a preserved specimen.

Agrotoreutus nyongii, new species

Figures 3, 5

12 clitellate specimens collected from the type-locality are now kept in the Museum of Natural History, University of Ife, Ile-Ife, Nigeria Reg. No. 1974.1.1-2.

2 clitellate specimens. British Museum (Natural History) Reg. No. 1974.17.8-9.

External characters: The lengths of the earthworms vary from 250 to 400 mm and the diameters in the widest region from 5 to 8 mm. The number of segments varies from 490 to 645, the clitellar segments are widest and the postclitellar segments are antero-posteriorly narrower than the preclitellar ones. The anterior portion of the body is pinkish whilst the posterior is bluish-purple. The body is not pigmented as the dorsal blood vessel, ventral vessel, the euprostate glands and parts of the spermathecal receptaculum show through it; the clitellum is dark yellow. The prostomium is prolobous. The clitellum is saddle-shaped, occupying segments XIV to XVII. Dorsal pores are absent.

The setal arrangement is eudriline with $ab > cd$; the setal formula (aa:ab:bc:cd) at segment X is 9:4:10:1, at segment XX = 9:3-6:8:1 and at segment XXX = 9:4:8:1. $aa < bc$ on segment X whereas $aa > bc$ on XX and XXX. $dd = \frac{1}{2}$ circumference.

The male pore is single between setal lines aa on 17/18 intersegmental furrow where it is situated on a raised papilla. Two pairs of penial setae are often found protruding through the pore.

The female pores are paired and they open out laterally in 13/14 intersegmental furrow, just ventral to the nephridiopores.

The spermathecal pore is single being situated on a papilla on furrow 20/21 or segment XXI between setal lines aa (Fig. 3).

A pair of rounded genital papillae (Fig. 3) are found occupying segments XX to XXII and another almond-shaped papilla occupying segments XXIII to XXXI midventrally. No other genital markings are present.

The nephridiopores are paired in the posterior wall of each furrow from segment III within setal lines cd.

Internal characters: The first septum, 4/5, is thin. Septum 5/6 is intermediate in thickness between the preceding septum and septa 6/7 to 10/11 which are thickened and conical. Septum 11/12 is thinner but conical.

The buccal cavity opens into a large, muscular pharynx which extends to segment IV where it leads into the oesophagus. A number of dilator muscles attach the wall of the pharynx to the body wall. The oesophagus dilates in segment V to form the large, muscular and almond-shaped gizzard. The oesophagus then passes posteriorly and it is undifferentiated apart from the three paired glands which are present as ventral reddish pouches, a pair in each of segments IX, X and XI, and the paired bean-shaped oesophageal glands dorsolaterally in segment XIII. The

intestine begins in segment XVII and runs uniformly throughout to the terminal anus. There are neither intestinal gizzards nor supra-intestinal glands, but a median typhlosole is present.

The dorsal blood vessel passes anteriorly along the intestine and the oesophagus to the pharynx. It is very large in segment XIII where it gives off two pairs of vessels. While the posterior pair serve the dorso-lateral oesophageal glands, the left anterior vessel serves the spermathecal ducts of its side, crosses over underneath the oesophagus and joins the right anterior vessel to run alongside the ventral nerve cord. This blood vessel later becomes the subneural vessel in segment XIX. In segments VI to XI, paired commissural blood vessels encircle the oesophagus and interconnect the supraoesophageal with the dorsal vessel segmentally before passing down to the ventral blood vessel. They become progressively larger from VI to XI and function as lateral hearts since they are all contractile. A supraoesophageal blood vessel exists in VI to XI, and in each of IX, X and XI, it gives off paired vessels to the ventral oesophageal glands. A suboesophageal vessel gives rise to two rather large blood vessels in VI. These vessels run underneath the oesophageal gizzard to serve the pharyngeal region. The ventral blood vessel gives off four pairs of vessels to the ovospermathecal complex in segment XIII and then runs over the receptaculum seminis alongside the nerve cord. It gives off several branches in segments XVI to XXI and then dips downwards to lie above the nerve cord for the remaining length of the animal.

The testes are holandric being paired in segments X and XI. Each is enclosed in a testis sac. A short duct leads posteriorly from the dorsal end of each testis sac through the septum into the seminal vesicle in the following segment. The testis sacs also contain the ciliated sperm funnels. The seminal vesicles are paired in segments XI and XII, the posterior pair being much larger. A vas deferens runs from the end of each testis sac and passes through the corresponding septum (10/11 and 11/12 respectively). The two vasa deferentia of each side unite in segment XIII and run posteriorly side by side over the parietal wall. From segment XIX, these ducts run along the edge of the euprostatic glands until they pass into these glands in segment XXII. The euprostatics are paired, muscular, elongated and sausage-shaped occupying segments XV or XVI to XXXII. They are narrow anteriorly (entally) and the tapering anterior ends of both glands meet below both the nerve cord and spermathecal atrium (Fig. 5) before opening out at the single ventral male pore in furrow 17/18. The pairs of penial setae which are curved at the tips and which are in form of rolled tubes join the euprostatics prior to their opening out.

The ovaries are paired in segment XIII and each with the ovisac is enclosed in a pink, transparent and thin-walled ovarian vesicle. An ovarian duct leads posteriorly from each ovary to join an efferent duct which leads into the receptaculum ovarum (fertilisation chamber). From

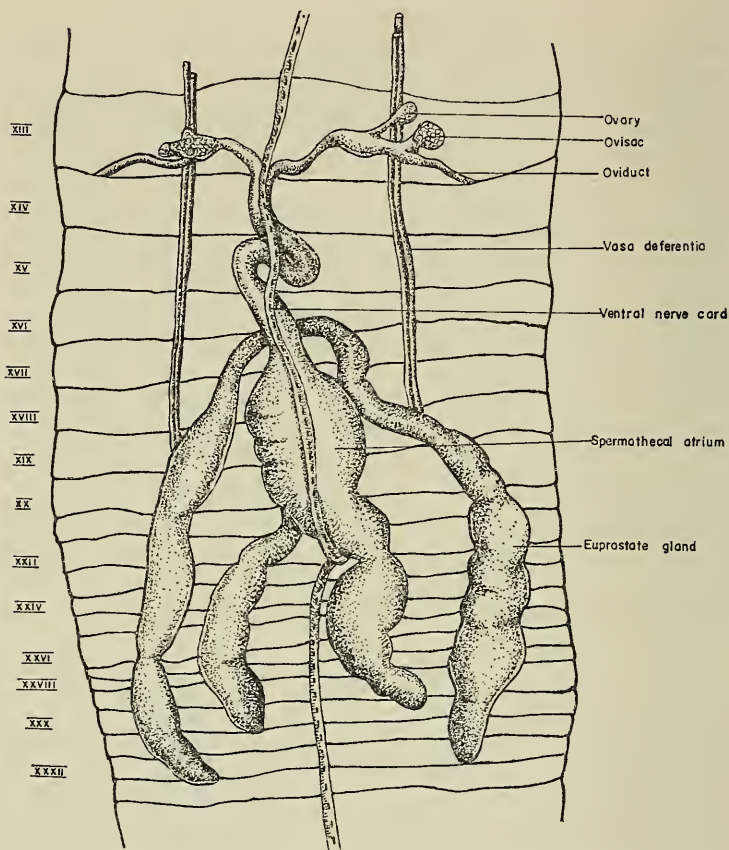


FIG. 5. *Agrotoreutus nyongii*, n. sp., reproductive system.

here, the oviduct leads posterolaterally to open out in 13/14 furrow (Fig. 5).

The spermathecal pore is single, midventral on 20/21 furrow and it leads into a muscular sac-like atrium which is situated below the ventral blood vessel and nerve cord. This immediately splits into two fingerlike, thin-walled appendages, the receptacula seminis, which occupy segments XXI to XXVIII, XXIX or XXX and in some cases to segment XXXIV on either side of the nerve cord. Anteriorly, the atrium maintains its baggy shape until it narrows in segment XVII to form a spermathecal tube. In segment XV, this tube bends upon itself to become U-shaped on the left side (sometimes to the right). It then bifurcates, immediately after penetrating 13/14 intersegmental septum, into right

and left narrow efferent ducts thereby becoming Y-shaped. This therefore means that the spermathecal system is paired both anteriorly and posteriorly, but remains single medially (Fig. 5).

The excretory system is meganephridial with one pair of nephridia to each of the segments from segment V backwards. Nephridia in the clitellar region are of the same size as the others.

ACKNOWLEDGMENTS

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